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ABSTRACT

Results of the American Institute of Physics' 1983-1984 survey of physics and astronomy bachelor's degree recipients are examined. The information was obtained from individual degree recipients with a focus on their plans after the baccalaureate program. Highlights of the findings are as follows: the proportion of women among 1984 physics bachelors increased 2 percentage points; 6 percent of undergraduate physics students are foreign; about 90 percent of physics bachelors graduates who are employment-oriented accept positions either before or shortly after graduation; industry continues to be the major employer of physics bachelors, followed by the military and civilian government agencies; for all employers combined, the median starting salary for physics bachelors rose 12 percent; and 70 percent of astronomy bachelors enter graduate schools. Data are included on: trends in postbaccalaureate plans of physics bachelors (1975-1984) and astronomy bachelors (1977-1984); characteristics of new physics bachelors and of new astronomy bachelors; postbaccalaureate plans of U.S. and foreign minorities among the 1984 physics bachelors; selected characteristics of minority physics bachelors, 1984; and changes in employment for new physics bachelors, 1974-1984. (SW)

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American Institute of Physics, 335 East 45 Street, New York, N.Y. 10017 (212) 661-9404

1983-84 SURVEY OF PHYSICS AND ASTRONOMY BACHELOR'S DEGREE RECIPIENTS

by Susanne D. Ellis AIP Pub. No. 211.16 March 1985

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1983–84 Survey of Physics and Astronomy Bachelor's Degree Recipients

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Since the late 1970's the number of physics bachelor's degrees granted has shown a gradual increase each year and the class of 1984 is no exception. Astronomy degrees, on the other hand, did not exhibit a similar trend. The survey upon which this report is based collects information from individual degree recipients and focuses on their postbaccalaureate plans. Gathering data for over twenty years from physics bachelors and for almost ten years from astronomy bachelors enables us to present trends and interpret changes. Highlights of the information presented in this report are:

→ An increase in the proportion of women among the physics bachelors.

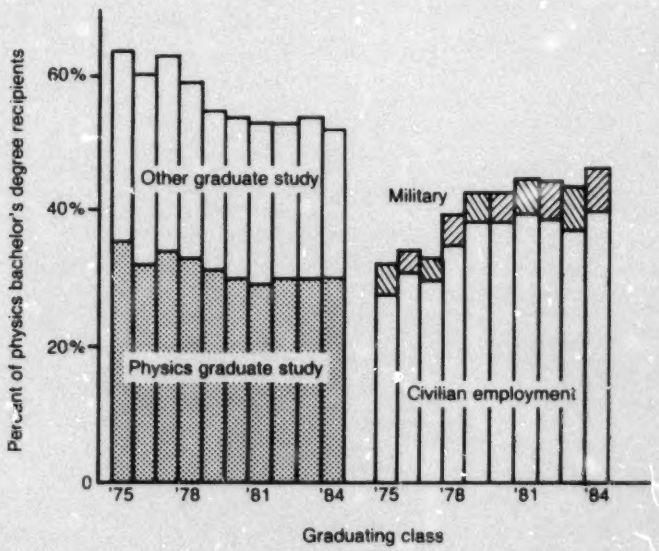
→ Fewer employment-oriented bachelors had accepted positions upon graduation.

→ Starting salaries paid by manufacturing industries rose only 3%.

The major career goals of physics bachelors fall into one of two categories: graduate study or employment, which for the class of 1984 indicate an almost even split. Both **Figure I** and **Table I** show the postbaccalaureate plans of physics bachelors for the past ten years and how small the changes were during that period. A further distinction included in **Figure I** is the relative proportion of bachelors who continue to study physics and those who switch to other disciplines of graduate study. Similarly, the employment-oriented graduates are divided into those entering civilian employment and those seeking a military career.

The numerical data for the bar graph of **Figure I** are presented in **Table I** which clearly indicates a leveling of the percentages

Figure I. Trend in postbaccalaureate plans of physics bachelors, 1975–1984.



of physics bachelors who enter graduate physics departments without interruption. Looking back to the class of 1975, the employment opportunities from the civilian sector appear to have improved steadily. The bottom row of **Table I** lists the total number of physics bachelor's degrees granted each year; data are derived from the departmental survey of Enrollments and Degrees.

Table I. Postbaccalaureate plans of successive graduating classes of physics bachelors, 1974–1984.

Postbaccalaureate plans	1974–75	1975–76	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83	1983–84
Physics graduate study	36%	32%	34%	33%	31%	30%	29%	30%	30%	30%
Other graduate study	27	28	28	26	24	24	24	23	24	22
Civilian employment	28	31	30	34	38	38	39	38	36	40
Military service	4	4	4	5	5	5	6	7	8	6
Undecided	5	5	4	2	2	3	2	2	2	2
Total number of physics bachelor's degrees	4571	4487	4517	4457	4416	4440	4513	4558	4795	4878

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Table II. Characteristics of new physics bachelors, 1983–84.

Characteristics	Graduate study		Postbaccalaureate plans		Total
	Physics	Other	Employment	Undecided	
Sex					
Female*	12%	15%	14%	18%	13.7%
Male	88	85	86	82	86.3
Citizenship					
U.S.	90%	92%	98%	94%	94.0%
Foreign	10	8	2	6	6.0
Age					
20 or younger	1%	1%	–	–	0.7%
21	8	7	2%	3%	5.1
22	48	50	37	48	43.6
23	22	23	25	11	23.2
24–27	15	14	24	24	19.2
28 or older	6	5	12	14	8.2
Minority groups					
U.S. blacks	1.0%	0.9%	3.0%	–	1.9%
Other U.S. minorities	5.1	4.3	3.6	15%	5.1
Foreign minorities	4.2	5.4	1.6	4	3.9
Double major					
Yes	25%	38%	26%	25%	28.6%
No	75	62	74	75	71.4
Type of undergraduate institution					
PhD-granting	56%	42%	42%	55%	44.7%
MS-granting	13	9	12	14	12.4
BS/BA-granting	31	49	46	31	42.9
Total number of bachelors	1475	1068	2245	90	4678
% distribution	30%	22%	46*	2%	100%
Number of respondents	740	536	1126	45	2447

**Percentage of women was adjusted for differential response rate.*

Major characteristics of new physics bachelors, as shown in **Table II**, can be identified more meaningfully when examined by subgroup. For example, looking at the age distributions of the graduates we find that employment-oriented bachelors tend to be older than those headed for graduate study. Traditionally, 22 was the most common age at which students completed their bachelor's degrees; however the data in **Table II** show that only half of the potential graduate students are age 22 and even fewer (37%) of the employment-oriented bachelors fall into that age group.

At the undergraduate level only six percent of the physics students are foreign; however, singling out those bachelors who have been accepted at graduate physics departments, we find that ten percent of them are foreign citizens. On the other hand employment-oriented bachelors include only two percent who are foreign.

Changes in characteristics from the previous year include a two percentage-point increase in the proportion of women as well as a small increase in U.S. minorities among the physics bachelors of 1984.

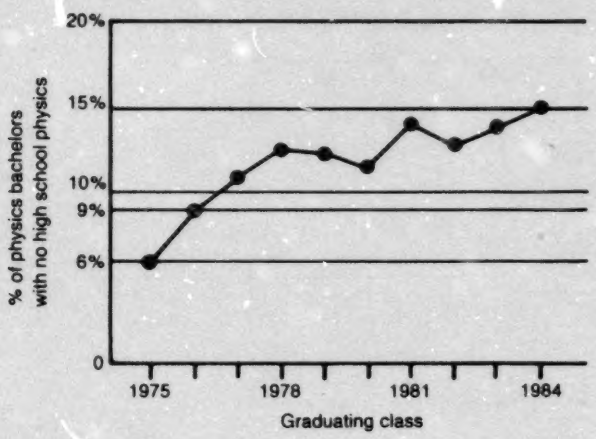
A major problem with the teaching of high school physics in the U.S. is that it is a local responsibility and no standard curriculum exists. Consequently there are many school districts that either do not offer physics at all, or do not offer it every year. To see what effect this situation had on those who completed physics bachelor's degrees, we asked what type of high school physics course, if any, the graduates had taken. Over two thousand individuals responded to that question. As shown in **Table III**, 17% of them indicated that they did not take any physics before entering college, a proportion which is slightly higher (20%) for physics bachelors who are women.

Table III. A comparison between men and women 1983–84 physics bachelors and their high school physics backgrounds.

Type of high school physics	Women	Men	Total %	Total N
PSSC*	20%	25%	25%	511
Project physics	10	12	12	245
Other	50	46	46	943
None	20	17	17	348
Total	100%	100%	100%	
Respondents N**	343	1704		2047

**PSSC = Physical Science Study Committee*
***Nonrespondents to the question = 400*

Figure II. Physics bachelors, entering graduate physics departments, who did not take high school physics, 1975 to 1984.



Since physicists are known to develop an interest in their discipline at an early age, we focused on the potential physicists among the physics bachelors to see what their high school physics backgrounds were. By "potential physicists" we mean those whose post-degree plan is graduate study in physics. Thus **Figure II** shows that back in 1975 only 6% of the potential physicists had not taken physics in high school, but by 1984 15% of the corresponding group fell into that category.

Having demonstrated in connection with **Table II** how the characteristics of a composite group can differ significantly from those of its component parts we apply a similar analysis in **Table IV** to the minority students among the physics bachelors. The postbaccalaureate plans of U.S. minority students as a whole are similar to those of all respondents in the class of 1984. However, by examining the plans of U.S. blacks and U.S. Orientals separately, we find that an above-average proportion of blacks seeks immediate employment, whereas above-average proportions of the Orientals enter graduate schools.

Different considerations should be applied to foreign minority students, who, like most foreign students, are in the U.S. on student visas which do not make them eligible for employment. Thus we find that a very large proportion of the foreign minorities (80%) plan to enter graduate school. As in past years, foreign Orientals are most likely to go on to physics graduate study.

Additional details on minorities are provided in **Table V**, which lists seven distinct minority groups and the numbers of physics bachelors who identified themselves with each group. The larger groups that are neither predominantly foreign nor predominantly U.S. are divided on the basis of citizenship and the following three characteristics are presented: sex, region and type of bachelor's institution. Thus the table indicates that U.S. blacks include the highest proportion of women and that they are concentrated in the four-year colleges. U.S. Orientals, on the other hand, tend to choose Ph.D.-granting institutions for their undergraduate studies. A conspicuous change from earlier years shown in **Table V** is the decrease in the number of Arab graduates. The 17 respondents included in this table represent a decline from 35 and 42 respondents in 1983 and 1982 respectively.

Table IV. Postbaccalaureate plans of U.S. and foreign minorities among the physics bachelors of the class of 1984.

Minorities	Postbaccalaureate plans: Graduate study: Physics	Graduate study: Other	Empl.	Total %	N
U.S. blacks	17%	11%	72%	100%	47
U.S. Orientals	40	26	34	100	50
Other U.S. minorities	35	23	42	100	57
Total U.S. minorities	30	19	51	100	154
Foreign Orientals	58%	27%	15%	100%	41
Other foreign minorities	43	34	23	100	53
Total foreign minorities	49	31	20	100	94
All respondents	30%	22%	48%	100%	2447

Table V. Selected characteristics of minority physics bachelors, 1984.

		Minority group: Black U.S.	Black Foreign	Mex. Amer.	Amer. Ind.	Hispanic U.S.	Hispanic Foreign	Oriental U.S.	Oriental Foreign	Asian Indian	Arab
	Total	47	13	12	14	13	10	50	41	12	17
Sex	Female	11	–	2	1	3	1	8	9	2	–
	Male	36	13	10	13	10	9	42	32	10	17
*Region of bach's inst.	Northeast	11	6	2	2	7	3	17	10	6	2
	Southeast	18	4	–	3	3	1	4	1	1	3
	Central & Mountain	16	3	5	5	3	2	11	20	2	5
	Pacific	2	–	5	4	–	4	18	10	3	7
Type of bach's inst.	PhD-granting	8	5	4	7	8	4	33	21	2	8
	MS-granting	9	–	2	1	1	4	4	1	1	4
	BS/BA-granting	30	8	6	6	4	2	13	19	9	5

**Regions: Northeast = New England, Middle Atlantic; Southeast = South Atlantic, East South Central; Central = East North Central, West North Central, West South Central.*

Table VI. Sources of anticipated support for first-year graduate study*, 1980–84.

Sources of support	Students planning: Physics graduate study 1980	1982	1984	Other graduate study 1980	1982	1984
Teaching assistantship	71%	64%	68%	26%	26%	32%
Research assistantship	12	15	13	24	20	15
Fellowship	10	12	11	12	15	12
Employment (part-time)	3	3	3	12	13	16
Family, savings, loan	2	4	4	23	23	22
Other	2	2	1	3	3	3
	100%	100%	100%	100%	100%	100%
Graduate study status: full-time	94%	94%	93%	90%	88%	83%
Graduate study status: part-time	6	6	7	10	12	17
Total number of full-time students	1332	1355	1475	1066	1066	1068

The information was reported for September of each academic year.

The most common type of support offered to first year graduate students is a teaching assistantship. **Table VI** is based on new physics bachelors who are interested in immediate full-time graduate study, and its data show that by studying physics rather than another graduate discipline, the student is twice as likely to be offered a teaching assistantship. Another major difference between the prospective physics graduate students and those switching to other disciplines is the proportion who report the use of personal funds. By combining "Employment (part-time)" and "Family, savings, loan," we find that only between 5% and 7% of the physics students were included in those categories, but over 35% of those interested in "other graduate study" reported these sources of support.

The lower portion of **Table VI** is based on a slightly larger group of new physics bachelors because it includes those who have accepted full-time employment and pursue graduate study on a part-time basis. In physics the part-time students comprise 6% or 7%, whereas those who enter "other graduate study" include between 10% and 17% part-time students.

Since almost half of the physics bachelors each year are interested in immediate employment, demand for them is an important piece of information to monitor annually. To accomplish that we ask each employment-oriented graduate for the number of job offers he or she received, which provides us with a scale of no offers, one offer, and multiple offers. **Table VII** presents these data consecutively for the years since 1980 and lists three years from the 1970's for comparison. It should be pointed out that "zero job offers" refers to the time immediately following graduation and should not be mistaken for a general unemployment rate. Thus an overall evaluation of the demand for physics bachelors is that close to 90% of the employment-oriented graduates accept positions either before or shortly after graduation; but ten years earlier the demand was considerably less.

Although postbaccalaureate plans have been discussed in connection with earlier figures and tables, the format of **Figure III** offers unique details. In particular it lists the major subjects of graduate study for those physics bachelors who chose a physics-related or another discipline for their graduate work. Also, it divides the employment-oriented graduates into categories which specify different stages of entry into the labor force.

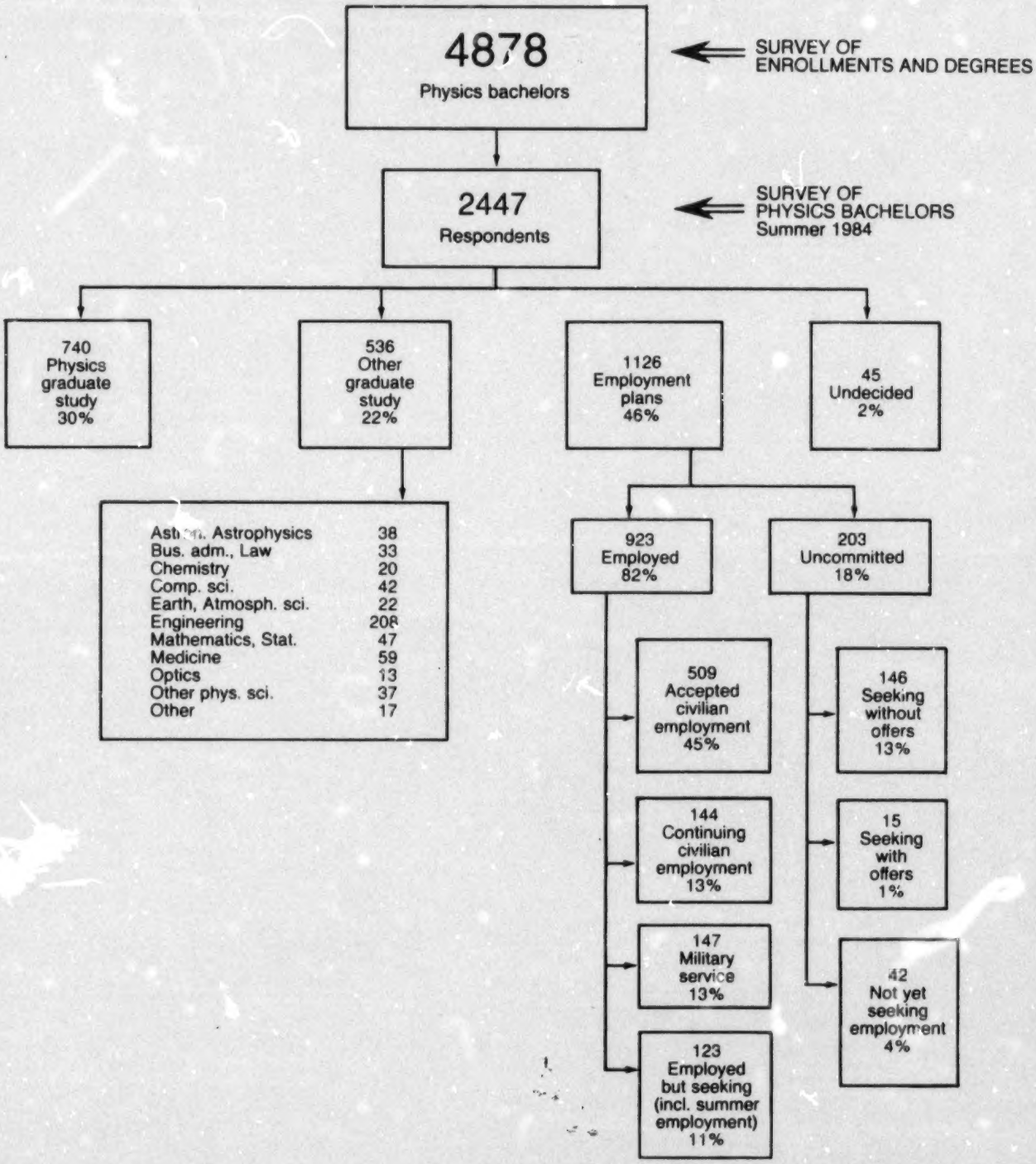
In regard to changes from the previous year, among the "other subjects of graduate study" engineering remained the one most frequently chosen and is followed by medicine, mathematics and computer science. Disciplines not obviously related to physics, such as business administration or law, have never attracted more than two or three percent of a year's graduates.

Table VII. Changes in employment outlook for new physics bachelors, 1974–1984.

Number of job offers at graduation	Summer 1974	Summer 1976*	Summer 1978	Summer 1980	Summer 1981	Summer 1982	Summer 1983	Summer 1984
0	18%	17%	10%	10%	10%	13%	11%	13%
1**	50	53	45	50	55	57	58	54
2 or more	32	30	45	40	35	30	31	33

These figures have been revised from those presented in earlier reports to include military commitments.
**Bachelors who enter the military service are included here.*

Fig. III. Postbaccalaureate plans of physics bachelors of the class of 1984.



A noteworthy change among the employment-oriented bachelors was a higher proportion of uncommitted graduates (18% compared with last year's 13%) which can be attributed to a three percentage-point difference in the group which is "not yet seeking employment" and a two percentage-point increase in those who are "seeking without offers." Although the group of "undecided" graduates has not changed in size in recent years, one can conclude from **Figure III** that there was an increase in graduates who are still in the process of deciding what to do; in spite of having accepted employment, they look for more appropriate positions.

Table VIII. Initial employment of physics bachelors, 1975–84.

Type of employer	Percentage of employed bachelors								
	1975–76	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83	1983–84
Industry { manufacture	30%	32%	37%	40%	41%	40%	38%	33%	38%
Industry { service	19	16	21	18	20	22	22	20	16
High school	11	8	7	6	3	2	3	4	4
College or university	4	5	3	4	3	4	4	4	5
Government { civilian	10	7	7	7	3	7	7	10	12
Government { military	13	12	14	15	16	21	24	27	24
Other	13	20	11	10	9	4	2	2	1
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

To get an accurate picture of where new physics bachelors find employment, we look at the types of employers reported by graduates in newly accepted potentially permanent positions. **Table VIII** compares the distribution of initial employers reported by the class of 1984 with those reported by earlier graduating classes and finds that industry continues to be the major employer, followed by the military and civilian government agencies. No significant change can be observed in the overall proportion of bachelors who accepted high school teaching positions, and low salaries may be one reason. According to **Table IX**, high schools pay the lowest median salaries. However a change from the previous year should be noted. The proportion of new women high school teachers doubled as their median starting salaries declined, while fewer men accepted high school positions at higher salaries than in the previous year. This phenomenon may be a reflection of the significant increase in the number of women among the employment-oriented graduates in the class of 1984. High school teaching allows them to utilize their physics training, a compensation to be weighed against a relatively low salary. For all employers combined the median starting salary rose 12%, an increase attributable to higher salaries offered by service industries and the civilian government agencies.

Tables VII through **IX** focus attention only on newly accepted employment thereby excluding the 144 graduates who had decided to remain with employers whom they worked for before receiving their bachelor's degrees (see **Fig. III**). **Table X** on the other hand includes the group described as "continuing civilian employment," because its members also hold full-time potentially permanent positions whose work activities and employers are of interest. Since industry employs a majority of the bachelors, research, development and design are the most frequently reported work activities. While the ability to program is often a skill acquired as part of a physics bachelor's degree, technical writing is not. However 25 respondents, among the 1984 graduates did report technical writing as their major work activity and thus are listed in **Table X**.

Table IX. Starting salaries of physics bachelors, 1984.

Type of employer	Men (470 reported salaries)		Women (90 reported salaries)		Total (560 reported salaries)	
	Dist. by employer	Median monthly salary	Dist. by employer	Median monthly salary	Dist. by employer	Median monthly salary
Industry { manufacture	38%	$2170	36%	$2100	38%	$2160
Industry { service	15	2040	17	2050	16	2040
High school	3	1200	12	1050	4	1100
College or university	4	1250	7	**	5	1230
Government { civilian	10	1750	10	1550	10	1690
Government { military	27	1520	13	1400	24	1510
FFRC	2	2200	5	1950	2	2150
Other	1	**	–	–	1	1250
Total	100%	$1870	100%	$1875	100%	$1870

***Insufficient data.*

Table X. Full-time employment* of new physics bachelors, 1984.

Work activity	Industry manufacture	Industry service	High school	Government civilian	Government military	Coll./ univ.	Other	Total N	Total %
Teaching	–	2	26	3	2	9	–	42	5
Res. & dev.	84	15	–	46	18	6	6	175	22
Dev. & design	88	22	–	14	9	3	5	141	18
Programming	46	42	3	22	5	10	2	130	16
Skilled work	51	16	–	4	10	13	1	95	12
Pilot/navigator training	–	–	–	–	43	–	–	43	5
Specialized training**	10	13	–	4	48	1	–	76	10
Technical writing	10	8	–	4	1	1	1	25	3
Other prof. work	–	3	2	2	7	2	5	21	3
Other	5	18	1	4	3	5	11	47	6
Total N	294	139	32	103	146	50	31	795	
Total %	37	18	4	13	18	6	4		100%

**The employment of these 795 graduates includes both newly accepted positions as well as those in which graduates are continuing. Excluded are graduates in temporary and summer employment.*
***Training paid for by the employer which includes 30 graduates sent to nuclear power school by the military.*

ASTRONOMY

When one thinks of vocationally-oriented students, astronomy majors do not come typically to mind. The postbaccalaureate plans of the 1984 graduates show that almost 70% of them will enter graduate schools with their newly acquired astronomy bachelor's degrees.

The format of **Table XI** is similar to that of **Table II** for physics bachelors because both tables relate major characteristics of bachelor's degree recipients to their postbaccalaureate plans. The response rate of astronomy bachelors is slightly higher than that of the physics bachelors but **Table XI** presents numbers instead of percentages for the individual subgroups because of the small number of respondents in each.

General observations show that an undergraduate astronomy curriculum is primarily offered at Ph.D.-granting institutions and attracts higher proportions of women and double majors than physics does. Also astronomy bachelors tend to be younger than their physics counterparts.

Going back to the late 1970's **Table XII** indicates a general decline in the number of bachelor's degrees over the seven-

Table XI. Characteristics of astronomy bachelors, 1984.

Characteristics		Postbaccalaureate plans: Graduate study: Astronomy N	Other N	Employment N	Undecided N	Total %
Sex	Female	6	5	10	–	28%
	Male	23	19	11	2	72
Citizenship	U.S.	27	23	21	2	96%
	Foreign	2	1	–	–	4
Type of high school physics**	PSSC*	5	5	1	–	18%
	Project physics	4	2	3	–	14
	Other	11	14	7	2	54
	None	5	–	4	–	14
Age	21 or younger	5	3	–	–	11%
	22 yrs.	15	13	13	1	55
	23 yrs.	7	7	5	–	25
	24 or older	2	1	3	1	9
Type of bachelor's institution	PhD-granting	23	19	12	1	72%
	MS-granting	4	1	2	–	9
	BS/BA-granting	2	4	7	1	19
Type of degree	Science	21	10	11	1	57%
	Arts	8	14	10	1	43
Double major	with physics	12	10	8	–	39%
	with mathematics	2	4	–	–	8
	with other	–	2	2	–	5
Total respondents		29	24	21	2	76

**PSSC = Physical Science Study Committee.*
***There were nonrespondents to this question.*

Table XII. Postbaccalaureate plans of successive graduating classes of astronomy bachelors, 1977–84.

Postbaccalaureate plans	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83	1983–84
Astronomy graduate study	33%	28%	35%	24%	29%	38%	38%
Other graduate study	22	19	17	13	25	17	31
Employment	40	51	43	59	45	41	28
Undecided	5	2	5	4	1	4	3
Total number of astronomy bachelors	177	165	165	156	181	138	137

year period. Consequently the number of respondents is decreasing proportionately thereby causing fluctuations in plans.

Figure IV offers additional details on the 76 astronomy bachelors and their postbaccalaureate plans. For example, 90% of those who go on to astronomy graduate study accepted assistantships or fellowships, and "other graduate study" generally includes many potential physicists. Of those who had accepted employment, only one bachelor evaluated his work activity as making extensive use of his astronomy training.

Fig. IV. Postbaccalaureate plans of astronomy bachelors of the class of 1984.